ESI

EnviroSystems, Inc.
P.O. Box 778
Hampton, NH 03843-0778
603-926-3345

December 12, 2017

Mr. Aram Varjabedian
Woodard & Curran
Hull Water Pollution Control Facility
1111 Nantasket Avenue
Hull, Massachusetts 02045

Dear Mr. Varjabedian:

Enclosed, please find three copies of our report presenting the results of a toxicity test completed using an effluent sample collected from the Hull, Massachusetts Water Pollution Control Facility during the November 2017 sampling period. Acute toxicity was evaluated using the inland silverside minnow, *Menidia beryllina*.

Please do not hesitate to call me or Lisa Bordonaro should you have any questions regarding the report.

Sincerely,

EnviroSystems, Incorporated

Lisa Bordonaro

Digitally signed by Lisa Bordonaro
DN: cn=Lisa Bordonaro, o=Envirosystems, Inc., ou=NPDES Laboratory Manager, email=lbordonaro@envirosystems.com, c=US
Date: 2017.12.12 12:04:36 -05'00'

Kirk Cram
Toxicology Laboratory Manager

Enclosure
WET Test Report Certification
Report Number 29958-17-11
Three (3) copies + email

WHOLE EFFLUENT TOXICITY TEST REPORT CERTIFICATION

Permittee Certification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Executed on: _____

_____

Authorized Signature

_____

Print or Type Name

Hull Permanent Sewer Commission

Print or Type the Permittee's Name

MA0101231

Type or Print the NPDES Permit No.

WHOLE EFFLUENT TOXICITY TEST REPORT CERTIFICATION (Bioassay Laboratory)

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Executed on: December 12, 2017

Kirk Cram
Toxicology Laboratory Manager - EnviroSystems, Inc.

TOXICOLOGICAL EVALUATION
OF A TREATED MUNICIPAL EFFLUENT
BIOMONITORING SUPPORT FOR A NPDES PERMIT:
November 2017

Hull Water Pollution Control Facility
Hull, Massachusetts
NPDES Permit Number MA0101231

Prepared For:

Woodard & Curran
Hull Water Pollution Control Facility
1111 Nantasket Avenue
Hull, Massachusetts 02045

Prepared By:

EnviroSystems, Incorporated
One Lafayette Road
Hampton, New Hampshire 03842

November 2017
Reference Number: Hull29958-17-11

STUDY NUMBER 29958

EXECUTIVE SUMMARY

The following summarizes the results of an acute exposure bioassay completed during November 2017 in support of the NPDES biomonitoring requirements of the Hull, Massachusetts Water Pollution Control Facility, operated by Woodard & Curran. The 48 hour acute definitive assay was completed using the inland silverside minnow, *Menidia beryllina*.

M. beryllina, supplied by Aquatic Research Organisms, Inc. of Hampton, New Hampshire, were 11 days old at the start of the test. Dilution water was receiving water collected from Massachusetts Bay at a point away from the discharge. Samples were received under chain of custody in good order. All sample receipt, test conditions and control endpoints were within protocol specifications, except where otherwise noted.

The results presented in this report relate only to the samples described on the chain(s) of custody and sample receipt log(s), and are intended to be used only by the submitter. Results from the acute exposure assay and their relationship to permit limits are summarized in the following matrix.

Acute Toxicity Evaluation

Species	Exposure	LC-50	A-NOEC	Permit Limit (LC-50)	Effluent Meets Permit Limit	Assay Meets Protocol Limits
Menidia beryllina [a]	48 Hours	>100%	100%	≥100%	Yes	Yes

COMMENTS:
NC = Not Calculated.
[a] Only 9 minnows were added to replicates A and D of the receiving water control at assay initiation; therefore, 9 organisms were used at the start of the assay in these replicates for the data summary and statistical analysis. 11 minnows were added to replicates B of the 12.5% test concentration, and B and C of the 50% test concentration at assay initiation; therefore, 11 organisms were used from the start of the assay in these replicates in the data summary and statistical analysis.

TOXICOLOGICAL EVALUATION
OF A TREATED MUNICIPAL EFFLUENT
BIOMONITORING SUPPORT FOR A NPDES PERMIT:
November 2017

Hull Water Pollution Control Facility
Hull, Massachusetts
NPDES Permit Number MA0101231

1.0 INTRODUCTION

This report presents the results of an acute toxicity test completed on a composite effluent sample collected from the Hull, Massachusetts Water Pollution Control Facility (Hull WPCF), operated by Woodard & Curran. Testing was based on programs and protocols developed by the US EPA (2002), with exceptions as noted by US EPA Region I (2012), and involved conducting a 48 hour static acute toxicity test with the inland silverside minnow, *Menidia beryllina*. Testing was performed at EnviroSystems, Incorporated (ESI), Hampton, New Hampshire in accordance with the provisions of TNI Standards (2009).

Acute toxicity tests involve preparing a series of concentrations by diluting effluent with control water. Groups of test animals are exposed to each effluent concentration and control for a specified period. In acute tests, mortality data for each concentration are used to calculate the median lethal concentration, or LC-50, defined as the effluent concentration that kills half of the test animals. Samples with high LC-50 values are less likely to cause significant environmental impacts. The no-effect concentration is also determined to provide information about the level of effluent that would have minimal acute effects in the environment. This Acute No Observed Effect Concentration (A-NOEC) is defined as the highest tested effluent concentration that causes no significant mortality.

2.0 MATERIALS AND METHODS

2.1 General Methods

Toxicological and analytical protocols used in this program follow procedures primarily designed to provide standard approaches for the evaluation of toxicological effects of discharges on aquatic organisms (US EPA 2002), and for the analysis of water samples (APHA 2012). See Section 4.0 for a list of references.

2.2 Test Species

When necessary, *M. beryllina* were acclimated to approximate test conditions prior to use in the assay. Test organisms were transferred to test chambers using an inverted glass pipet, minimizing the amount of water added to test solutions. Twenty control fish were weighed during the test to confirm loading rates. The loading rate was below the maximum 0.4 g/L recommended for assays conducted at 25°C. Fish weights and loading calculations are included in the data appendix. Fish were fed <24 hour old *Artemia* nauplii daily until test start.

2.3 Effluent, Receiving Water, and Laboratory Water

Effluent and receiving water collection information is provided in Table 1. Samples were received at 0-6°C as per 40 CFR §136.3 unless otherwise noted, stored at 4±2°C and warmed to 25±1°C prior to preparing test solutions. Effluent used in the *M. beryllina* assay was salinity adjusted to 25±2 ppt using artificial sea salts according to protocol (US EPA 2002). Laboratory water was collected from the Hampton/Seabrook Estuary. This water has been used to culture marine test organisms since 1981.

Total residual chlorine (TRC) was measured by amperometric titration (MDL 0.02 mg/L) in the effluent and diluent samples prior to use in the assays. Samples with ≥0.02 mg/L TRC were dechlorinated using sodium thiosulfate (US EPA 2002) and a control treatment using laboratory water adjusted with the same amount of sodium thiosulfate as was used to dechlorinate the effluent was run concurrently with the assay.

If sample pH measured <6.0 SU or >9.0 SU, samples were adjusted using sodium hydroxide or hydrochloric acid, respectively, and a control treatment using laboratory water adjusted with the same amount of either compound as was used to modify sample pH was run concurrently with the assay. When applicable, data from sodium thiosulfate and/or pH adjusted laboratory control treatments can be found in Appendix A.

2.4 Acute Exposure Bioassay

The 48 hour static acute exposure bioassay was conducted at 25±1°C with a photoperiod of 16:8 hours light:dark. Test chambers were 250 mL glass beakers containing 200 mL test solution in each of 4 replicates with 10 organisms/replicate. Replicates were not randomized during testing; rather, organisms were added randomly at test initiation by replicate across test solutions in an alternating fashion (alternating allocation). Test concentrations for the assay were 100% (undiluted), 50%, 25%, 12.5%, and 6.25% effluent. Survival and dissolved oxygen were recorded daily in all replicates. Specific conductivity, salinity, temperature, and pH were measured daily in one replicate of each test treatment.

2.5 Data Analysis

When applicable, statistical analysis of acute exposure data was completed using CETIS™ v1.9.3.0, Comprehensive Environmental Toxicity Information System, software. The program computes acute exposure endpoints based on US EPA decision tree guidelines specified in individual test methods. If survival in the highest test concentration is >50%, the LC-50 is obtained by direct observation of the raw data. As needed, the A-NOEC is determined as the highest test concentration that caused no significant mortality.

2.6 Quality Control

As part of the laboratory quality control program, standard reference toxicant assays are completed on a regular basis for each test species. These results provide relative health and response data while allowing for comparison with historic data sets. See Table 2 for details.

3.0 RESULTS AND DISCUSSION

Results of the acute exposure bioassay completed using the inland silverside minnow are summarized in Table 3. Effluent and dilution water characteristics are presented in Table 4. US EPA Region I toxicity test summary sheets can be found after the tables. Support data, including copies of laboratory bench sheets, are included in Appendix A.

Minimum test acceptability criteria require ≥90% survival in the control concentrations. Achievement of these results indicates that healthy test organisms were used and that the dilution water had no significant adverse impact on the outcome of the assay. See the Executive Summary and Table 3 for test acceptability.

4.0 LITERATURE CITED

40 CFR §136.3. *Code of Federal Regulations* (CFR), Protection of the Environment (Title 40), Guidelines Establishing Test Procedures for the Analysis of Pollutants (Part 136), Identification of Test Procedures (sub-part 3), Table II-Required Containers, Preservation Techniques, and Holding Times.

APHA. 2012. *Standard Methods for the Examination of Water and Wastewater*, 22nd Edition. Washington D.C.

The NELAC Institute (TNI). 2009. *Environmental Laboratory Sector, Volume 1: Management and Technical Requirements for Laboratories Performing Environmental Analysis (TNI Standard)*. EL-V1-2009.

US EPA. 2002. *Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms*. Fifth Edition. EPA-821-R-02-012.

US EPA Region I. 2012. *Marine Acute Toxicity Test Procedure and Protocol.* US EPA Region I Office, Boston, Massachusetts. July 2012.

TABLE 1. Summary of Sample Collection Information.
Hull WPCF Effluent Biomonitoring Program. November 2017.

Sample Description	Type	Collection Date	Collection Time	Receipt Date	Receipt Time	Arrival Temp °C
Effluent	Comp	11/14-15/17	0800-0800	11/15/17	0838	5
Receiving Water	Grab	11/15/17	0600	11/15/17	0838	5

TABLE 2. Summary of Reference Toxicant Data.
Hull WPCF Effluent Biomonitoring Program. November 2017.

Date	Endpoint		Value	Historic Mean/ Central Tendency	Acceptable Range	Reference Toxicant
M. beryllina						
11/28/17	Survival	48Hr LC-50	7.9	7.0	5.5 - 8.6	SDS (mg/L)

Means and Acceptable Ranges based on the most recent 20 reference toxicant assays.

TABLE 3. Summary of Acute Evaluation Results.
Hull WPCF Effluent Biomonitoring Program. November 2017.

Percent Survival

Species	Exposure	Lab	RW	6.25%	12.5%	25%	50%	100%
M. beryllina	48 hours	95%	91.9% [a]	93.0%	100% [b]	83.0%	95.2% [b]	98.0%

LC-50 and A-NOEC Results

Species	Exposure	Spearman-Kärber	Probit	Direct Observation	A-NOEC
M. beryllina	48 Hours	NC	NC	>100%	100%

COMMENTS:
RW = Receiving Water; used as the diluent.
NC = Not Calculated.
[a] Only 9 minnows were added to replicates A and D of the receiving water control at assay initiation; therefore, 9 organisms were used at the start of the assay in these replicates for the data summary and statistical analysis. 11 minnows were added to replicates B of the 12.5% test concentration, and B and C of the 50% test concentration at assay initiation; therefore, 11 organisms were used from the start of the assay in these replicates in the data summary and statistical analysis.

TABLE 4. WET Support Chemistry Data.
Hull WPCF Effluent Biomonitoring Program. November 2017.

PARAMETER	UNIT	EFFLUENT	RECEIVING WATER
Specific Conductivity - As Received	µmhos/cm	17880	47740
pH - As Received	SU	7.27	7.79
Salinity - As Received	ppt	11	31
Total Residual Chlorine	mg/L	<0.02	<0.02
Total Solids	mg/L	12000	36000
Total Suspended Solids	mg/L	14	4.8
Ammonia as N	mg/L	0.17	<0.1
Total Organic Carbon	mg/L	4.7	2
Aluminum, total	mg/L	0.035	0.075
Cadmium, total	mg/L	<0.0005	<0.0005
Calcium, total	mg/L	162	363
Chromium, total	mg/L	<0.002	<0.002
Copper, total	mg/L	0.011	0.0011
Lead, total	mg/L	<0.0005	<0.0005
Magnesium, total	mg/L	365	1080
Nickel, total	mg/L	<0.002	<0.002
Zinc, total	mg/L	0.058	0.0026

COMMENTS:
Additional water quality and support chemistry data are provided in Appendix A.

TOXICITY TEST SUMMARY SHEET

FACILITY NAME: Hull WPCF TEST START DATE: 11/16/17
NPDES PERMIT NO.: MA0101231 TEST END DATE: 11/18/17

TEST TYPE	TEST SPECIES	SAMPLE TYPE	SAMPLE METHOD
X Acute	___ *Pimephales promelas*	___ Prechlorinated	___ Grab
___ Chronic	___ *Ceriodaphnia dubia*	___ Dechlorinated	X Composite
___ Modified Chronic (Reporting Acute Values)	___ *Daphnia pulex*	___ Chlorine Spiked in Lab	___ Flow-thru
	___ *Americamysis bahia*	___ Chlorinated on Site	___ Other
	___ *Cyprinodon variegatus*	___ Unchlorinated	
___ 24 Hour Screen	X *Menidia beryllina*	X No Detectable Chlorine Upon Receipt	
	___ *Arbacia punctulata*	___ Dechlorinated at lab	

DILUTION WATER:

X Receiving water collected at a point upstream or away from the discharge, free from toxicity or other sources of contamination; Receiving Water Name: Massachusetts Bay

___ Alternate surface water of known quality and hardness, to generally reflect the characteristics of the receiving water; Receiving Water Name: _____

___ Synthetic water prepared using either Millipore Milli-Q or equivalent deionized water and reagent grade chemicals; or deionized water combined with mineral water.

___ Artificial sea salts mixed with deionized water

___ Deionized water and hypersaline brine

___ Other

EFFLUENT SAMPLING DATES: 11/14-15/17 _____ _____

EFFLUENT CONCENTRATIONS TESTED (%): 6.25; 12.5; 25; 50; 100

Permit Limit Concentration: ≥100 %

Was the effluent salinity adjusted? Yes If yes, to what level? 25 ppt

REFERENCE TOXICANT TEST DATE: 11/28/17 LC-50: 7.9 mg/L Sodium Dodecyl Sulfate

PERMIT LIMITS AND TEST RESULTS

Test Acceptability Criteria

Mean Control Survival: 91.9 %

LIMITS		RESULTS	
LC-50:	≥100 %	LC-50	>100 %
		Upper Limit:	- %
A-NOEC:	- %	Lower Limit:	- %
		Method:	Direct Observation
C-NOEC:	- %	A-NOEC:	100 %
		C-NOEC:	- %
		C-LOEC:	-
IC- ___	- %	IC- ___	- %

APPENDIX A

DATA SHEETS

STATISTICAL SUPPORT

METHODS USED IN NPDES PERMIT BIOMONITORING TESTING

Parameter	Method
Acute Exposure Bioassays:	
Ceriodaphnia dubia	EPA-821-R-02-012 2002.0
Daphnia pulex	EPA-821-R-02-012 2021.0
Pimephales promelas	EPA-821-R-02-012 2000.0
Americamysis bahia	EPA-821-R-02-012 2007.0
Menidia beryllina	EPA-821-R-02-012 2006.0
Cyprinodon variegatus	EPA-821-R-02-012 2004.0
Chronic Exposure Bioassays:	
Ceriodaphnia dubia	EPA-821-R-02-013 1002.0
Pimephales promelas	EPA-821-R-02-013 1000.0
Cyprinodon variegatus	EPA-821-R-02-014 1004.0
Menidia beryllina	EPA-821-R-02-014 1006.0
Arbacia punctulata	EPA-821-R-02-014 1008.0
Champia parvula	EPA-821-R-02-014 1009.0
Trace Metals:	
Trace Metals	EPA 200.8/SW 6020, EPA 245.7
Hardness	EPA SW846 3rd Ed. 6010
Wet Chemistries:	
Alkalinity	EPA 310.2
Chlorine, Residual	Standard Methods 22nd Edition - Method 4500-Cl D
Total Organic Carbon	Standard Methods 22nd Edition - Method 5310 C
Specific Conductance	Standard Methods 22nd Edition - Method 2510 B
Nitrogen - Ammonia	Standard Methods 22nd Edition - Method 4500-NH_3 G
pH	Standard Methods 22nd Edition - Method 4500-H+ B
Solids, Total (TS)	Standard Methods 22nd Edition - Method 2540 B
Solids, Total Dissolved (TDS)	Standard Methods 22nd Edition - Method 2540 C
Solids, Total Suspended (TSS)	Standard Methods 22nd Edition - Method 2540 D
Dissolved Oxygen	Standard Methods 22nd Edition - Method 4500-O G

Please visit our web site at www.envirosystems.com for a copy of our accreditations and state certifications.

The Commonwealth of Massachusetts

Department of Environmental Protection

Division of Environmental Analysis

Senator William X. Wall Experiment Station

certifies

M- NH906

ENVIROSYSTEMS INC
1 LAFAYETTE RD
HAMPTON, NH 03842-0000

Laboratory Director: **RUSSELL D. FOSTER**

for the analysis of **NON POTABLE WATER (CHEMISTRY)**

pursuant to 310 CMR 42.00

This certificate supersedes all previous Massachusetts certificates issued to this laboratory. The laboratory is regulated by and shall be responsible for being in compliance with Massachusetts regulations at 310 CMR 42.00.

This certificate is valid only when accompanied by the latest dated Certified Parameter List as issued by the Massachusetts D.E.P. Contact the Division of Environmental Analysis to verify the current certification status of the laboratory.

Certification is no guarantee of the validity of the data. This certification is subject to unannounced laboratory inspections.

Issued: **01 JUL 2017**

Expires: **30 JUN 2018**

Oscar C. Pancoast

Director, Division of Environmental Analysis

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Certified Parameter List as of: 01 JUL 2017

M-NH906 **ENVIROSYSTEMS INC**
HAMPTON NH

NON POTABLE WATER (CHEMISTRY) **Effective Date** **17 MAY 2017** **Expiration Date** **30 JUN 2018**

Analytes	Methods
ALUMINUM	EPA 200.8
ANTIMONY	EPA 200.8
ARSENIC	EPA 200.8
BERYLLIUM	EPA 200.8
CADMIUM	EPA 200.8
CHROMIUM	EPA 200.8
COBALT	EPA 200.8
COPPER	EPA 200.8
IRON	EPA 200.8
LEAD	EPA 200.8
MANGANESE	EPA 200.8
MERCURY	EPA 245.7
MOLYBDENUM	EPA 200.8
NICKEL	EPA 200.8
SELENIUM	EPA 200.8
SILVER	EPA 200.8
THALLIUM	EPA 200.8
VANADIUM	EPA 200.8
ZINC	EPA 200.8
PH	SM 4500-H-B
SPECIFIC CONDUCTIVITY	SM 2510B
ALKALINITY, TOTAL	EPA 310.2
CHLORIDE	SM 4500-CL-C
CHLORIDE	EPA 300.0
SULFATE	EPA 300.0
AMMONIA-N	SM 4500-NH3-B, G
NITRATE-N	SM 4500-NO3-F
KJELDAHL-N	SM 4500-NH3-B, G
ORTHOPHOSPHATE	SM 4500-P-E
PHOSPHORUS, TOTAL	SM 4500-P-B,E
BIOCHEMICAL OXYGEN DEMAND	SM 5210B
TOTAL ORGANIC CARBON	SM 5310C
CYANIDE, TOTAL	SM 4500-CN-C,E
NON-FILTERABLE RESIDUE	SM 2540D
OIL AND GREASE	EPA 1664
VOLATILE HALOCARBONS	EPA 624
VOLATILE AROMATICS	EPA 624
CHLORDANE	EPA 608
ALDRIN	EPA 608
DIELDRIN	EPA 608
DDD	EPA 608
DDE	EPA 608
DDT	EPA 608

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Certified Parameter List as of: 01 JUL 2017

M-NH906 **ENVIROSYSTEMS INC**
HAMPTON NH

NON POTABLE WATER (CHEMISTRY) **Effective Date** **17 MAY 2017** **Expiration Date** **30 JUN 2018**

Analytes	Methods
HEPTACHLOR	EPA 608
HEPTACHLOR EPOXIDE	EPA 608
SVOC-ACID EXTRACTABLES	EPA 625
SVOC-BASE/NEUTRAL EXTRACTABLES	EPA 625
POLYCHLORINATED BIPHENYLS (WATER)	EPA 608

ACUTE BIOASSAY DATA SUMMARY

STUDY: 29958	Brine Shrimp: A- 4729	"AS RECEIVED" EFFLUENT AND DILUENT CHEMISTRIES								
CLIENT: Woodard & Curran	TEST ORGANISM: *M. beryllina*		T. Metals	TOC	AMM	TS/TSS	pH	S/C	SALINITY	TRC
SAMPLE: Hull WWTF Effluent	ORGANISM SUPPLIER / BATCH / AGE: *See Organism Culture Sheet*	EFF	002	003	004	005/006	7.27	17880	10.6	<0.02
DILUENT: Receiving Water		DIL		0089 (AS 11/15)	010	011/012	7.79	47740	31.2	<0.02

SALINITY ADJUSTMENT RECORD : 3,500 ML EFFLUENT + 58.1 G SEA SALTS (A- 4682) = 100% ACTUAL PERCENTAGE
SAL. ADJ. RW: 7,500 mL Receiving + 2,000 mL DI H2O = 78.9 % Actual

CONC	REP	SURVIVAL 0	SURVIVAL 24	SURVIVAL 48	DO (mg/L) 0	DO 24	DO 48	pH (SU) 0	pH 24	pH 48	TEMP (°C) 0	TEMP 24	TEMP 48	S/C (µmhos/cm) 0	S/C 24	S/C 48	SALINITY (ppt) 0	SALINITY 24	SALINITY 48
LAB SALT	A	10	10	9	8.1	7.0	7.0	7.92	7.71	7.77	23	24	24	~~40980~~ 38150 (MW 11/16)	39170	39500	~~30~~ 25 (MW 11/16/17)	25	25
	B	10	10	10	8.1	6.9	6.8												
	C	10	10	9	8.1	6.9	6.7												
	D	10	10	10	8.1	6.5	6.6												
RW	A	10	9 (E10 CFS 11/17)	8	7.6	6.2	6.6	7.84	7.74	7.82	23	24	24	38920	40120	41420	25	25	26
	B	10	10	10	7.6	6.3	6.6												
	C	10	9	9	7.6	6.3	6.6												
	D	10	9 (E10 CFS 11/17)	8	7.6	6.2	6.5												
6.25%	A	10	9	8	7.7	6.1	6.6	7.83	7.73	7.84	23	24	24	39230	40590	41380	25	26	26
	B	10	10	9	7.7	6.1	6.5												
	C	10	10	10	7.7	6.1	6.6												
	D	10	10	10	7.7	6.1	6.6												
12.5%	A	10	10	10	7.7	6.1	6.6	7.83	7.74	7.83	23	24	24	39380	40700	41630	25	26	27
	B	10	11	11	7.7	6.1	6.5												
	C	10	10	10	7.7	6.1	6.5												
	D	10	10	10	7.7	6.4	6.5												
DATE		11/16	11/17/17	11/18	11/16/17	11/17/17	11/18												
TIME		1410	1215	~~1215~~ (KB 11/18)	1220	0920	0910												
INITIALS		KB	CFS	~~KB~~ GRS (KB 11/18)	MW	MW	CFS												

(E10) LB 11/20/17 12.5% B 11 orgs from start in data sum + stats

(E10) CFS, 11/17
– only 9 organisms in beaker, with no corpses

(E11) CFS, 11/17
– size/age variation observed in all concentrations. Some of the smaller variants seem to not be eating.

(E11) LB 11/20/17 9 orgs from start in data sum + stats

ACUTE BIOASSAY DATA SUMMARY

STUDY: 29958	Brine Shrimp: A- 4729	
CLIENT: Woodard & Curran	TEST ORGANISM: *M. beryllina*	
SAMPLE: Hull WWTF Effluent	ORGANISM SUPPLIER / BATCH / AGE: *See Organism Culture Sheet*	
DILUENT: Receiving Water		

CONC	REP	SURVIVAL 0	SURVIVAL 24	SURVIVAL 48	DO (mg/L) 0	DO (mg/L) 24	DO (mg/L) 48	pH (SU) 0	pH (SU) 24	pH (SU) 48	TEMP (°C) 0	TEMP (°C) 24	TEMP (°C) 48	S/C (µmhos/cm) 0	S/C (µmhos/cm) 24	S/C (µmhos/cm) 48	SALINITY (ppt) 0	SALINITY (ppt) 24	SALINITY (ppt) 48
25%	A	10	10	6	7.8	6.1	6.6	7.83	7.82	7.91	23	24	24	39600	40600	41990	25	26	27
	B	10	10	10	7.8	6.0	6.6												
	C	10	9	7	7.8	6.0	6.6												
	D	10	10	10	7.8	6.0	6.6												
50%	A	10	10	10	7.8	6.1	6.6	7.83	7.90	7.99	23	24	24	39550	40540	41850	25	26	27
	B	10	11	10	7.8	6.1	6.6												
	C	10	11	11	7.8	6.1	6.6												
	D	10	9	9	7.8	6.0	6.6												
100%	A	10	10	10	7.8	6.0	6.5	7.83	7.97	8.09	23	24	24	39410	40460	41630	25	26	27
	B	10	10	10	7.8	6.1	6.7												
	C	10	10	10	7.8	6.1	6.7												
	D	10	10	9	7.8	6.0	6.6												
DATE		11/16	11/17/17	11/18/17	11/16/17	11/17/17	11/18												
TIME		1410	1215	1215	1226	0920	0910												
INITIALS		KB	CFS	GRS	MW	MW	CFS												

EIO 11/20/17
50% B+C 11 orgs from start in data sum+ stats

CETIS Summary Report

Menidia beryllina 48-Hr Acute Survival Test — **EnviroSystems, Inc.**

Batch ID:	11-0636-9594	**Test Type:**	Survival	**Analyst:**	Lisa Bordonaro
Start Date:	16 Nov-17 14:10	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	Receiving Water
Ending Date:	18 Nov-17 12:15	**Species:**	Menidia beryllina	**Brine:**	Generic commercial salts
Duration:	46h	**Source:**	ARO - Aquatic Research Organisms, NH	**Age:**	11d

Sample ID:	02-9791-7691	**Code:**	29958	**Client:**	Woodard & Curran, Inc.
Sample Date:	15 Nov-17 08:00	**Material:**	WWTP, Municipal Treatment Plant	**Project:**	Fourth Quarter WET Compliance Test
Receipt Date:	15 Nov-17 08:38	**Source:**	Hull MA WWTF		
Sample Age:	30h (5 °C)	**Station:**	MA0101231		

Multiple Comparison Summary

Analysis ID	Endpoint	Comparison Method	NOEL	LOEL	TOEL	TU	PMSD ✓
07-9478-2023	Proportion Survived	Steel Many-One Rank Sum Test	100	> 100	n/a	1	19.2%

Proportion Survived Summary

Conc-%	Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	LS	4	0.950	0.858	1.000	0.900	1.000	0.029	0.058	6.08%	0.00%
0	RW	4	0.919	0.834	1.000	0.889	1.000	0.027	0.054	5.87%	3.22%
6.25		4	0.925	0.773	1.000	0.800	1.000	0.048	0.096	10.35%	2.63%
12.5		4	1.000	1.000	1.000	1.000	1.000	0.000	0.000	0.00%	-5.26%
25		4	0.825	0.497	1.000	0.600	1.000	0.103	0.206	24.99%	13.16%
50		4	0.952	0.864	1.000	0.900	1.000	0.028	0.055	5.80%	-0.24%
100		4	0.975	0.895	1.000	0.900	1.000	0.025	0.050	5.13%	-2.63%

Proportion Survived Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4
0	LS	0.900	1.000	0.900	1.000
0	RW	0.889	1.000	0.900	0.889
6.25		0.800	0.900	1.000	1.000
12.5		1.000	1.000	1.000	1.000
25		0.600	1.000	0.700	1.000
50		1.000	0.909	1.000	0.900
100		1.000	1.000	1.000	0.900

Menidia beryllina 48-Hr Acute Survival Test — **EnviroSystems, Inc.**

Analysis ID:	07-9478-2023	**Endpoint:**	Proportion Survived	**CETIS Version:**	CETISv1.9.3
Analyzed:	20 Nov-17 12:29	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes
Sample ID:	02-9791-7691	**Code:**	29958	**Client:**	Woodard & Curran, Inc.
Sample Date:	15 Nov-17 08:00	**Material:**	WWTP, Municipal Treatment Plant	**Project:**	Fourth Quarter WET Compliance Test
Receipt Date:	15 Nov-17 08:38	**Source:**	Hull MA WWTF		
Sample Age:	30h (5 °C)	**Station:**	MA0101231		

Data Transform	Alt Hyp	NOEL	LOEL	TOEL	TU	PMSD
Angular (Corrected)	C > T	100	> 100	n/a	1	19.20%

Steel Many-One Rank Sum Test

Control	vs	Conc-%	Test Stat	Critical	Ties	DF	P-Type	P-Value	Decision(α:5%)
Receiving Water		6.25	19.5	10	2	6	Asymp	0.9315	Non-Significant Effect
		12.5	24	10	1	6	Asymp	0.9989	Non-Significant Effect
		25	17	10	1	6	Asymp	0.7334	Non-Significant Effect
		50	22.5	10	2	6	Asymp	0.9944	Non-Significant Effect
		100	23	10	2	6	Asymp	0.9966	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.137709	0.0275419	5	1.37	0.2831	Non-Significant Effect
Error	0.362983	0.0201657	18			
Total	0.500693		23			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance Test	23.4	15.1	2.8E-04	Unequal Variances
Distribution	Shapiro-Wilk W Normality Test	0.978	0.884	0.8479	Normal Distribution

Proportion Survived Summary

Conc-%	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	RW	4	0.919	0.834	1.000	0.894	0.889	1.000	0.027	5.87%	0.00%
6.25		4	0.925	0.773	1.000	0.950	0.800	1.000	0.048	10.35%	-0.60%
12.5		4	1.000	1.000	1.000	1.000	1.000	1.000	0.000	0.00%	-8.76%
25		4	0.825	0.497	1.000	0.850	0.600	1.000	0.103	24.99%	10.27%
50		4	0.952	0.864	1.000	0.955	0.900	1.000	0.028	5.80%	-3.57%
100		4	0.975	0.895	1.000	1.000	0.900	1.000	0.025	5.13%	-6.04%

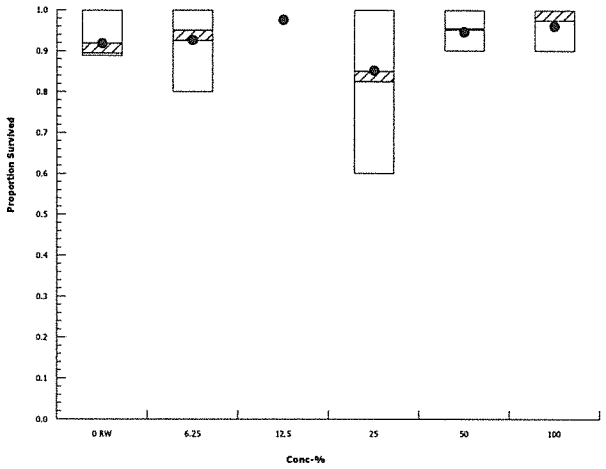
Angular (Corrected) Transformed Summary

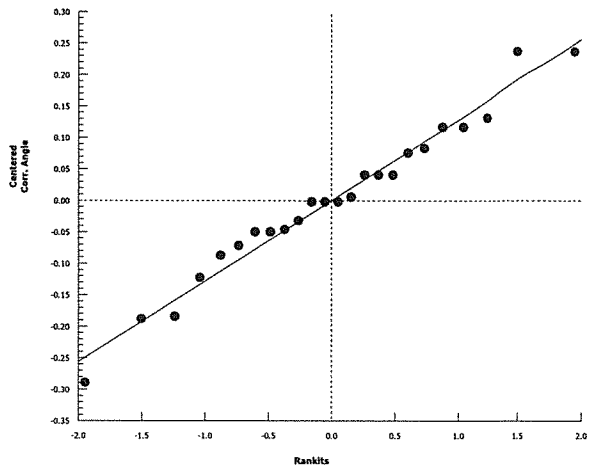
Conc-%	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	RW	4	1.28	1.14	1.42	1.24	1.23	1.41	0.044	6.87%	0.00%
6.25		4	1.3	1.06	1.53	1.33	1.11	1.41	0.0735	11.35%	-1.12%
12.5		4	1.41	1.41	1.42	1.41	1.41	1.42	0.00187	0.26%	-10.39%
25		4	1.18	0.735	1.62	1.2	0.886	1.41	0.138	23.54%	8.23%
50		4	1.34	1.19	1.48	1.34	1.25	1.42	0.046	6.89%	-4.33%
100		4	1.37	1.24	1.5	1.41	1.25	1.41	0.0407	5.94%	-7.07%

Menidia beryllina 48-Hr Acute Survival Test — **EnviroSystems, Inc.**

Analysis ID:	07-9478-2023	**Endpoint:**	Proportion Survived	**CETIS Version:**	CETISv1.9.3
Analyzed:	20 Nov-17 12:29	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Graphics





STUDY: 29958
CLIENT: Hull
PROJECT:
ASSAY: MB48AD
SPECIES: *M. beryllina*
TASK: **Wet Weight Data - Balance Output File**
BALANCE: **Ohaus Discovery Balance Model DV215CD**
Serial #: **1124024313**

Date / Intials:	11/16/17 MW	MW
Rep		
1	0.00296	
2	0.00085	
3	0.00114	
4	0.00052	
5	0.00229	
6	0.00171	
7	0.00305	
8	0.00107	
9	0.00067	
10	0.00075	
11	0.00154	
12	0.00021	
13	0.00044	
14	0.00076	
15	0.00081	
16	0.00154	
17	0.00112	
18	0.00096	
19	0.00064	
20		
Mean Weight (g):	0.00121	
Test Volume (L):	0.2	
Loading Rate(g/L):	0.06061	

10M6AR011517

Aquatic Research Organisms

DATA SHEET

I. Organism History

Species MENIDIA BERYLLINA

Source: Lab reared ✓ Hatchery reared _____ Field collected _____

Hatch date 11-5-17 Receipt date _____

Lot number 110217MB Strain _____

Brood origination _____

II. Water Quality

Temperature 25 °C Salinity ~28 ppt D.O. — ppm

pH 7.8 su Hardness — ppm Alkalinity — ppm

III. Culture Conditions

Freshwater _____ Saltwater ✓ Other _____

Recirculating ✓ Flow through _____ Static renewal _____

DIET: Flake food ✓ Phytoplankton _____ Trout chow _____

Artemia ✓ Rotifers ✓ YCT _____ Other EWCAP Shrimp Diet

Prophylactic treatments: _____

Comments: _____

_____

IV. Shipping Information

Client: ESI # of Organisms 7000+

Carrier: _____ Date shipped 11-15-17

Biologist: Mark Voorneveld

PO BOX 1271 HAMPTON NH 03843-1271 (603) 926-1650 AROFISH@AOL.COM

RECORD OF METERS USED

STUDY: 29958		CLIENT: Woodard & Curran - Hull, MA WWTF	
Exposure (Hours)			
	0	24	48
Water Quality Station #	1	1	1
Initials / Date	MW 11/16/17	MW 11/17/17	CFS 11/18/17

Water Quality Station #1		Water Quality Station #2		COMMENTS
DO meter #	24	DO meter #		
DO probe #	95	DO probe #		
pH meter #	1097	pH meter #		
pH probe #	149	pH probe #		
S/C meter #	YSI30D	S/C meter #		
S/C probe #	↓	S/C probe #		
Salinity meter #		Salinity meter #		

PREPARATION OF DILUTIONS

Diluent: Receiving Water (RW)	Day: 0 Sample: $E_0 D_0$ E_0 = 27.0°C D_0 = 24.4°C	
Concentration %	Vol. Eff.(mls)	Final Vol.(mls)
Lab Salt	0	800 mL
RW	0	↓
6.25%	50	
12.5%	100	
25%	200	
50%	400	
100%	800	
INITIALS:	AK	
TIME:	1135	
DATE:	11/16/17	

Report No: 29958 SDG:
Project: Hull

Sample ID: Effluent Start
Matrix: Water
Sampled: 11/15/17 0800

Parameter		Result	Quant Limit	Units	Date Prepared	Date of Analysis	INIT/Method/Reference
Total solids	29958-006	12000	100	mg/L	11/17/17 1405	11/21/17 0940	CA /SM 2540B
Total suspended solids	29958-005	14	2	mg/L	11/16/17 1115	11/17/17 1035	CA /SM 2540D
Total organic carbon	29958-003	4.7	0.4	mg/L	11/22/17	11/22/17	BS /SM 5310 C
Ammonia-N	29958-004	0.17	0.1	mg/L as N	11/24/17 1100	11/24/17 1230	BS /SM 4500-NH3 G
Aluminum, total	29958-002	0.035	0.02	mg/L	11/29/17 0915	11/29/17 2212	JLH/EPA 200.8
Cadmium, total	29958-002	ND	0.0005	mg/L	11/29/17 0915	11/29/17 2212	JLH/EPA 200.8
Calcium, total	29958-002	162	0.1	mg/L	11/29/17 0915	11/29/17 2212	JLH/EPA 200.8
Chromium, total	29958-002	ND	0.002	mg/L	11/29/17 0915	11/29/17 2212	JLH/EPA 200.8
Copper, total	29958-002	0.011	0.0005	mg/L	11/29/17 0915	11/29/17 2212	JLH/EPA 200.8
Lead, total	29958-002	ND	0.0005	mg/L	11/29/17 0915	11/29/17 2212	JLH/EPA 200.8
Magnesium, total	29958-002	365	0.1	mg/L	11/29/17 0915	11/29/17 2212	JLH/EPA 200.8
Nickel, total	29958-002	ND	0.002	mg/L	11/29/17 0915	11/29/17 2212	JLH/EPA 200.8
Zinc, total	29958-002	0.058	0.002	mg/L	11/29/17 0915	11/29/17 2212	JLH/EPA 200.8

Sample ID: Receiving Water Start
Matrix: Water
Sampled: 11/15/17 0600

Parameter		Result	Quant Limit	Units	Date Prepared	Date of Analysis	INIT/Method/Reference
Total solids	29958-012	36000	100	mg/L	11/17/17 1405	11/21/17 0940	CA /SM 2540B
Total suspended solids	29958-011	4.8	2	mg/L	11/16/17 1115	11/17/17 1035	CA /SM 2540D
Total organic carbon	29958-009	2	2	mg/L	12/10/17	12/10/17	BS /SM 5310 C
Ammonia-N	29958-010	ND	0.1	mg/L as N	11/24/17 1100	11/24/17 1230	BS /SM 4500-NH3 G
Aluminum, total	29958-008	0.075	0.02	mg/L	11/29/17 0915	11/29/17 2218	JLH/EPA 200.8
Cadmium, total	29958-008	ND	0.0005	mg/L	11/29/17 0915	11/29/17 2218	JLH/EPA 200.8
Calcium, total	29958-008	363	0.1	mg/L	11/29/17 0915	11/29/17 2218	JLH/EPA 200.8
Chromium, total	29958-008	ND	0.002	mg/L	11/29/17 0915	11/29/17 2218	JLH/EPA 200.8
Copper, total	29958-008	0.0011	0.0005	mg/L	11/29/17 0915	11/29/17 2218	JLH/EPA 200.8
Lead, total	29958-008	ND	0.0005	mg/L	11/29/17 0915	11/29/17 2218	JLH/EPA 200.8
Magnesium, total	29958-008	1080	0.1	mg/L	11/29/17 0915	11/29/17 2218	JLH/EPA 200.8
Nickel, total	29958-008	ND	0.002	mg/L	11/29/17 0915	11/29/17 2218	JLH/EPA 200.8
Zinc, total	29958-008	0.0026	0.002	mg/L	11/29/17 0915	11/29/17 2218	JLH/EPA 200.8

Notes:

ND = Not Detected

SAMPLE RECEIPT AND CONDITION DOCUMENTATION

STUDY NO:	29958		
SDG No:	Hull		
Project:	Hull		
Delivered via:	ESI		
Date and Time Received:	11/15/17 0838	Date and TIme Logged into Lab:	11/15/17 1538
Received By:	MG	Logged into Lab by:	MS MS
Air bill / Way bill:	No	Air bill included in folder if received?	NA
Cooler on ice/packs:	Yes	Custody Seals present?	NA
Cooler Blank Temp (C) at arrival:	5.2 C	Custody Seals intact?	NA
Number of COC Pages:	1		
COC Serial Number(s):	A1015534		
COC Complete:		Does the info on the COC match the samples?	Yes
Sampled Date:	Yes	Were samples received within holding time?	Yes
Field ID complete:	Yes	Were all samples properly labeled?	Yes
Sampled Time:	Yes	Were proper sample containers used?	Yes
Analysis request:	Yes	Were samples received intact? (none broken or leaking)	Yes
COC Signed and dated:	Yes	Were sample volumes sufficient for requested analysis?	Yes
Were all samples received?	Yes	Were VOC vials free of headspace?	NA
Client notification/authorization:	Not required	pH Test strip ID number:	A-4734

Field ID	Lab ID	Mx	Analysis Requested	Bottle	Req'd Pres'n	Verified Pres'n
Effluent Start	Lab ID	W	MB48AD StartSample	1x3750 P	4 C	
Effluent Start	29958-002	W	Total Metals Cd,Cr,Ni,Pb,Cu,Zn,Al,Ca,Mg;	250 P	HNO3	Yes
Effluent Start	29958-003	W	TOC	1x40 G	H2SO4	Yes
Effluent Start	29958-004	W	NH3;	125 P	H2SO4	Yes
Effluent Start	29958-005	W	TSS	1000 P	4 C	
Effluent Start	29958-006	W	TS	250 P	4 C	
Receiving Water Start	29958-007	W	MB48AD StartDiluent	2x3750 P	4 C	
Receiving Water Start	29958-008	W	Total Metals Cd,Cr,Ni,Pb,Cu,Zn,Al,Ca,Mg;	250 P	HNO3	Yes
Receiving Water Start	29958-009	W	TOC	1x40 G	H2SO4	Yes
Receiving Water Start	29958-010	W	NH3;	125 P	H2SO4	Yes
Receiving Water Start	29958-011	W	TSS	1000 P	4 C	
Receiving Water Start	29958-012	W	TS	250 P	4 C	

Notes and qualifications:

See COC

ESI EnviroSystems, Inc.
1 Lafayette Road
Hampton, NH 03842

Voice: 603-926-3345
FAX: 603-926-3521

ESI Job No: 29958

CHAIN OF CUSTODY DOCUMENTATION

Client: Hull	Contact: Aram Varjabedian	Project Name: Hull WWTF	
Report to: Aram Varjabedian	Address: 1111 Nantasket Avenue	Project Number: P0036	Task: 0001
Invoice to: Aram Varjabedian	Address: Hull, MA 02045	Project Manager: Aram Varjabedian	
Voice: 781-925-0906	Fax: 781-925-3056	email:	P.O.No: ' Quote No:41181

Protocol: NPDES

Lab Number (assigned by lab)	Your Field ID: (must agree with container)	Date Sampled	Time Sampled	Sampled By	Grab or composite (G/C)	Container No	Container Size (mL)	Container Type (P/G/T)	Field Preservation	Matrix S=Solid W=Water	Filter N=Not needed F=Done in field L=Lab to do	Analyses Requested\ Special Instructions:
001	Effluent Start	11/14-15/17	8A-8A		C	1	3750	P	4 C	Water	N	MB48AD StartSample
002	Effluent Start	11/14-15/17	8A-8A		C	1	250	P	HNO3	Water	N	Total Metals Cd,Cr,Ni,Pb,Cu,Zn,Al,Ca,Mg;
003	Effluent Start	11/14-15/17	8A-8A		C	1	40	G	H2SO4	Water	N	TOC
004	Effluent Start	11/14-15/17	8A-8A		C	1	125	P	H2SO4	Water	N	NH3;
005	Effluent Start	11/14-15/17	8A-8A		C	1	1000	P	4 C	Water	N	TSS
006	Effluent Start	11/14-15/17	8A-8A		C	1	250	P	4 C	Water	N	TS
007	Receiving Water Start	11/15/17	6 AM		G	2	3750	P	4 C	Water	N	MB48AD StartDiluent
008	Receiving Water Start	11/15/17	6 AM		G	1	250	P	HNO3	Water	N	Total Metals Cd,Cr,Ni,Pb,Cu,Zn,Al,Ca,Mg;
009	Receiving Water Start	11/15/17	6 AM		G	1	40	G	H2SO4	Water	N	TOC
010	Receiving Water Start	11/15/17	6 AM		G	1	125	P	H2SO4	Water	N	NH3;
011	Receiving Water Start	11/15/17	6 AM		G	1	1000	P	4 C	Water	N	TSS
012	Receiving Water Start	11/15/17	6 AM		G	1	250	P	4 C	Water	N	TS

Relinquished By: Date: 11/15/17 Time: 8:38 AM — Received By: Date: 11/15 Time: 8:38

Relinquished By: Date: Time: — Received at Lab By: Date: Time:

Comments: 5.2°C

ERR

COC Number: A1015534

Sample Delivery Group No: Nov 2017 — Page of

Assay Review Checklist

DATE IN: 11/26/17 (11/27/17)
DATE DUE: 12/07/17

STUDY#: 29958
CLIENT: Woodard + Curran
PROJECT: Hull
ASSAY: MB48AD

Project Paperwork Check for Completeness	Date	Initials	Comments
Day 0	11/16/17	KB	
Day 1	11/17/17	CFS	
Day 2	11/18/17	GRS	
Day 3			
Day 4			
Day 5			
Day 6			
Day 7			
Day 8			

Analyst Data Review	Date	Initials	Comments
Chains of Custody Complete	11/18/17	GRS	
Sample Receipt Complete	↓	↓	
Organism Culture Sheet(s)	↓	↓	
Bench Sheets Complete (dates, times, initials, etc...)	↓	↓	
Water Quality Data Complete	↓	↓	
TRC Values & Bottle Numbers	↓	↓	
Daphnid Calculations Complete	NA	NA	
Weights Reported	11/18/17	GRS	
Assay Acceptability Review	↓	↓	

Technical Report Review	Date	Initials	Comments
Statistical Analysis Complete	11/20/17	UB	
Statistical Analysis Reviewed	11/28 29/17	AK	
Data Acceptability Review	11/20/17	UB	MB-RW A+D only 9 orgs from start
Supporting Chemistry Report	12/12/17	UB	-12.5% B, +50% B+C 11 orgs from start
Draft Report	11/21/17	UB	
QA Audit/Review Complete			
Final Report Reviewed	11/29/17	AK	
Final Report Printed - PDF	12/12/17	UB	
Executive Summary / Chems Sent			
Report E-mailed / Faxed	12/12/17	UB	
Report Logged Out / Invoice Sent	↓	↓	
Report Scanned to Archive	↓	↓	

P:\GENERAL PROJECTS\FORMS\LABFORMS\$ Assay Review Checklist.wpd